# PURPOSIVENESS IN NATURE AND LIFE.

"Et rien, afin que tout dure,
Ne dure éternellement."
—Malherbe, *La Prise de Marseille.*

AN ordering process amid the ceaseless flow of things has been observed since the beginning of thought about them, and is still the chief material of our anthropomorphisms, gross and refined. We may neglect the flow in our effort to attend to the things, or ignore the things in our overwhelming sense of the flow, but sooner or later the conviction is borne in upon us that nature has some mode of moving or acting, some way of dividing or uniting, which can take none of its wonderful potency from the mere peradventure of chance. How are we to explain the adjustments and adaptations which, in both inorganic and organic, present the world to us as everywhere shot through and through with mind? Why should the universe, like the intellect, segregate and classify, bringing likes together and separating or assimilating unlikes? What is it that matches the rounded boulder with the sphered planet, and shapes the orbits of worlds and the orbits of electrons on the same plan; that relates the spiral of the nebula and of the shell to the volute of the Ionic capital, and these to the curl of the wave as it breaks on the shore; that passes from regularly spaced ether pulses to regularly spaced air waves, sand waves and ocean rollers, to re-appear in the iterated lines of decorative art; that makes one the geometry of the crystal and the geometry

of the honeycomb, the intelligence that moulds the dandelion seed to the wind and the intelligence which builds up human industry, navigates the seas and explores the heavens?

Underlying all anthropomorphism, whether it frankly assimilates nature to man's bodily characteristics, or more subtly reads into it his will and mind, has been the sense that we are in some sort one with the universe and are entitled to fashion it in our own image. But we have selected for our material of interpretation not the deepest and hidden characters of our being, but rather the things most obvious to us as sentient organisms. Our very idea of intelligence is so bound up with conscious and voluntary experiences that these have become for our thinking the *sine qua non,* if not the very essence, of so-called purposiveness. Are our own ends consciously realized? Is human planning inconceivable save as the outcome of consciousness and will? Then all arrangements that suggest contrivance by being directed to end must be similarly determined. Regarding intelligence as constituted of its conspicuous instead of its fundamental characters, we thus commit ourselves to the task of finding will and consciousness in the world at large. Here is the royal and easy road to the elucidation of "design in nature." In this view there can be no purposiveness save as the result of the sentience we associate with mind. But in the deeper insight we are emancipated from so embarrassing a superficiality. Instead of being rounded off by consciousness and will, intelligence is there seen to be the ways in which we act and think, not our awareness of those ways; so purposiveness, whether highly complex, as in organisms, or relatively simple as in the inorganic, is recognized as not primarily feeling, consciousness, or will as such, however closely it may come to be implicated with these, but primarily a mode of motion, a method of change, which has its

roots in the very nature of power. Out of the process thus deeply grounded come the forms that are purposive because they endure, and endure because they are purposive. Change may indeed be the unmaking as well as the making of form, yet nature's richly stored workshop shows us everywhere a final triumph of the ordered over the fortuitous tendencies. The fundamental character of change turns out to be not merely a continuation of the "immobile," but the setting up of form; the fundamental character of form manifests itself not merely as "a snap-shot view of a transition," but as an end or result which is reached and maintained. It is vain to tell us that reality is only the flux of things, and may be summed up as the ceaseless upspringing of something new. What we confront is a vast cosmic drift towards purposive configurations, towards intelligent adaptations, towards symmetry, beauty, harmony, and therefore towards good.

## DYNAMIC INTELLIGENCE.

Now the trend towards forms which are purposive because they endure, and endure because they are purposive, is writ large in the visible phenomena around us because it is first writ small, yet all the more potently, in the ground of things. The immediate source of this drift is the so-called conservation of energy, applied as a doctrine in physics to moving bodies; yet maintenance thus conceived is only the more obvious and superficial aspect of a conservation wide and deep as the cosmos itself. Beneath all the vicissitudes which submit themselves to the ordering process is the endurance of that which changes; earlier than motion is the conservation of the things which move and of the ether or power system from which they emerge and with which they are one. If the ether be granular, as there is reason to believe, the universe accessible to knowledge must be envisaged as a unity of dynamic oppo-

sites, of ultimate elements stressing and stressed, each requiring all and all insisting on each. Summated as part contributing to whole, as whole arrayed against part, this insistence on the one by the many emerges as an ever-present and everywhere exercised function of cosmic self-conservation. Before the appearance of matter, maintenance is effected without translatory motion. As likes, holding and held, the power elements are in equilibrium; the antagonism which they exert and to which they are subject is the same for all of them throughout the cosmos. Stresses and re-stresses are everywhere balanced. There is everywhere incoming and outgoing strain kept from change by likeness, and only awaiting difference to manifest itself as motion. And translatory motion begins when, by some modification of the units—possibly by partial coalescence of them into definite groupings—ether gives rise to matter. Were only one material unit formed it would not move, since the stress on it would be the same from every direction. But when many such units are produced, the relation between them and the system which we call gravitative springs up. It is not inconceivable that they shield each other in some way from a total stress which acts on all; but whatever the explanation, we must assume that the pressure inward from without all such bodies is greater than is exerted by the ether system outward from within them. And with the advent of matter and of matter in motion comes the drift towards forms and configurations that endure.

All kinds of motion in the universe may be traced to differential stresses whose goal is equalization, and therefore endurance. Inorganic matter does not move "of its own accord." If the stresses on a body from all directions are equal, it will remain at rest; if it be stressed more from one direction than from all other directions it will move. Set in motion where there is no resistance, it continues to

move, and the energy expended in setting it in motion is conserved for future delivery whenever resistance is encountered. Where motion occurs through a resisting medium or against resisting objects, the initial energy is distributed as motion through the resistances. As the energy of moving bodies is a secondary form of the constitutive cosmic energy, so motion is a secondary form of cosmic self-maintenance, since it secures the continuance, either as kinetic or potential, of the energy expended in producing it. Power is two-sided: the unit of it must everywhere have against it an opposing, but at the same time a supporting universe. So in the realm of motion, there must arise instantaneously or ultimately re-stresses equal in amount to the originating stresses. The universe is a self-complicating and a self-ordering because self-maintaining system: it must develop the differences which are its superficial and temporary character; it must insist on the likenesses, on the two-sidedness, which is its fundamental and enduring character. As motion is a way or means by which differential stresses sooner or later automatically eliminate themselves, all change may be regarded as a procession towards conditions of equalized stress. In this way single bodies under differential stress reach positions of rest by motion through their resisting environment; in this way moving configurations, from atom to solar system, have their differentials automatically equalized and harmonized. Where stresses are not equal, change proceeds until by motion away from the direction of greatest stress towards the direction of least stress the collocations, configurations and forms which endure are set up. Objectively regarded, these are ways or means to endurance, and it is because they realize the end of endurance that they display "intelligent adaptation" character, suggest purposiveness, give rise to the idea of contrivance or plan, seem put together that they may continue. The link be-

tween contrivance by man and purposiveness in nature is thus the link of an underlying process common to both and out of which both arise. Due neither to consciousness nor will, intimately as it may come to be bound up with these, intelligence is fundamentally dynamic, belongs to the inorganic before the advent of life-forms, and as modes of motion directed to end, culminating in maintenance, is rooted in the very nature of power.

### TELEOLOGY IN THE ORGANISM.

The same drift towards endurance reappears in the organism, not as totally new, but as fundamentally old. The principle of continuity would alone entitle us to regard the living system as derivatively modelled after the cosmic system from which it emerges. What we find in the transition from inorganic to organic is passage from the non-living material unit which is universe-maintained to the vital aggregate which maintains itself, with the function of conservation complicated, but not obscured, by the peculiar conditions under which matter ascends to protoplasmic rank. The electrons, atoms, molecules of an inorganic body are held in existence by the universe—do not depend for their "properties" on the material aggregate which they unite to form. A molecule of iron remains a molecule of iron however the size of the mass to which it belongs may vary. But in living matter these elementary parts, built up into complex units highly sensitive to the inner environment which all of them form for each, have their functioning and structure determined by the nature and activities of the system as a whole. Made up of interdependent elements, each necessary to all, all insisting on each, the one everywhere contributing, the many everywhere dominating, the organism is committed by its very nature to self-maintenance. The differential stress which ensures motion towards the end of endurance is thus

exerted as the power of the whole; the path of least stress for both unit and system is the direction leading towards activities and structures that secure self-maintenance. That the organism does not merely "hold together," but comes internally and relationally to be motile, results from expenditures of energy for self-maintenance and from the involved need of replenishment from without. Repair of structures metamorphosed or injured flows directly from the impulsion to self-maintenance. Any inroad upon normal completeness brings a tension to bear on the whole system, and the organism finds it easier to relieve that tension by repair than to reaccommodate its whole structure to the changed conditions. It is only a more intense, because organized, form of that strain which is seen in reproduction by means of specialized germ-cells developed to secure endurance threatened by the inevitableness of death.

How is the organism guided to the intelligent adaptations which insure self-maintenance? What gives it the semblance of a series of appliances, machine-like, intelligently contrived, for doing the work of life? How does it come to suggest a subtle arrangement of parts put together for a purpose? Man fashions a tool or machine because he is aware beforehand what shapes or collocations will lead to the desired results. The organism, which works unconsciously, has no such prevision based on experience. Its process must be one of effects achieved from instant to instant. How can it reach end by means adapted to secure end? We find the answer to this question by realizing to ourselves the meaning of that original set of the organic system towards self-maintenance which has been either ignored or naively taken for granted in the theory of natural selection. The "contriver" is neither an inner consciousness obscurely or clearly aware of the right means, nor an outer intelligence working as artificer in

relation to his machine, but the system itself plus the motion process. The "plan" in accordance with which the intelligent adaptations are to unfold is implicit in the organism at the very outset of its career. The system has had organic property imposed upon it—the property of life—and is under impulsion to work only in ways that secure self-maintenance. And the impulsion is not due to a "vital force" mysteriously permeating the organism and urging it to intelligent action. It proceeds from the organic units summated as a whole, the one subordinated, the many dominating, and all making an inner environment for each. It is an internal stress of the system on its parts, a dynamic thrust through which each unit and group of units finds what it must do marked out for it by physical influence passed from unit to unit and exerted upon every unit by its immediate environment of units. In this sense, but in this alone, the determination to self-maintenance and to self-maintaining activities is projected forward, as it were, by the nature of the system, just as, though in a far less complex way, the "affinities" of the atom are projected forward by the nature of the atom. In this sense the easiest path for organisms and organic parts is predetermined. Impelled to self-maintenance, it imposes subfunctions of maintenance on the parts, and these in working, however inadequately at the beginning, are guided by the process which automatically compels change as long as there is differential stress, and automatically ceases to compel it when conditions of equalized stress have been attained. It is out of this impulsion of the whole to self maintenance, this imposition of vital, end-reaching activities on the parts, and this subjection of system and parts to the motion process, that tissues and organs gradually arise. In their beginnings they work against friction, with much waste of power and failure of efficiency. But the resistances they encounter operate as dif-

ferential stresses, and it is by the impact of these that the adaptations are gradually perfected and acquire "intelligent" because efficient form. As long as there is an attainable economy which is not reached, change goes on by motion away from the direction of greatest stress towards the direction of least stress until the appliance or organ has acquired its efficiency maximum. Intelligent adaptations in the organic realm, given the nature of the organic system as a self-maintainer, are thus products of differential stresses that have automatically eliminated themselves by motion. They are enduring forms just because of this elimination. They are "intelligent" because they are ways by which self-maintenance is secured, and not because of their need of any conscious or psychical element to make them intelligent. Certain ends of the organism come finally to be secured by conscious, voluntary action, but even for these there is the same underlying nature of the system impelling to self-maintenance, and the same resistances to action functioning as moulders of intelligent adaptations. As the time-and-space resistances which oppose themselves to our use of a blunt tool lead to the sharpening of it, so do such resistances work to the perfection of our machines and the facilitation of our enterprises. In organism and universe, then—in the one because in the other—self-maintenance is the function of the system as a whole, and differential stresses, working through motion to set up equalized stresses, determine how self-maintenance shall be achieved. For the narrower view of it the process seems mechanical; in the wider view it is seen to be teleological. Causality and teleology, in other words, belong together. However subject to delays and reversals, the teleology of the cosmos is an elementary anticipation of the more complex and precise teleology of the organism. However disguised by consciousness and will, the teleol-

ogy of the organism does but expand and write large the cosmic drift towards enduring forms.

### DYNAMIC MEMORY.

Thus far we have dealt with organic development in its phylogenetic aspect. Let us now consider the ontogeny of the system. Why does endurance necessitate reproduction, and why does self-maintenance show itself in the form of heredity? How does it come about that, in the phenomena of growth, the parent or parents should be imitated, recapitulated, and with such a degree of exactness as to suggest conscious and voluntary mimicry of the past? What if it should turn out that this form of memory is neither conscious nor voluntary, but purely dynamic? For answer to these questions we need to examine the reproductive process at its very origin. For life will be found to begin in the active resistance which the organic system offers, not to diminution, but to increase of its bulk. The first synthesis of protoplasm from inorganic matter brings not only increased complexity of material, but also organization of the elements aggregated. Under the domination of the system, configurations arise in adaptation to it and to one another. As the bulk of the whole goes on augmenting by further aggregation, the adaptation of the unit lags behind the structural character of the system, and this lag, in spite of slow modification, is a continually increasing value. The resulting tension between system and unit, the latter clinging to a structure required in the past, the former requiring a unit structure suited to the present, finally reaches a critical stage, whereupon the system divides into equal parts. By this division, which has many analogues in animal societies, the strain is relieved. But the products of the division do not remain quiescent. The hand of the past is upon them. Another tension, individual and collective, is now theirs—the tension of incompleteness.

Accustomed to a larger system, and made up of units more or less definitely adapted to it, they are now impelled to complete themselves, and to do this in a particular way. The time-and-space order of change with which they have been impressed summons them to the repetition of that order by definite and precise vicissitudes. Under stress from the dominating system, not as existing merely in the present, but as a time-and-space whole, they find it easier to build up the old conditions then to readapt themselves to the new. Continually receiving fresh material from the outer world, they not only mould that material into the accustomed forms, but also impress upon the elements assimilated the power to assist in further assimilation until the original system has been completely reproduced. The objective type or plan of the mature organism to be thus exists in the product of division or reproductive germ as a series of paths of least stress and greatest stress towards which and away from which it must move. Growth is the recapitulation of those experiences of activity and structure which, by interadaptation of the units, the dominating whole has made easiest for all of them. It represents the passing over of differential stresses into equalized stresses, involving changes of form along with changes of place; it is an aspect of end-reaching, the completion of the organism being an end for all the units and for each of them. It is therefore, objectively speaking, a means to self-maintenance.

The phenomena of heredity thus require us to regard the organism not merely as a structure in the present, but also as a process in time. The whole which at any particular instant determines to self-maintenance is at once structure-whole and process-whole. As the unit structures are interadapted and thus come to be insisted on by the system, so are their unit time phases interdependent and interdetermining: they constitute an order of change on

which the dominating system insists. And the method by which the time phases are enforced along with the spatial structures resembles memory just because the underlying process of memory is dynamic, and not in any sense conscious or voluntary. We are enabled to learn by heart because the brain units engaged acquire an order of change to which the whole brain system adapts itself, and on which, because of that adaptation—arraying the many against the one—the brain system insists. The "affinities" of the inorganic atom remain the same, whatever may have been its experiences; the behavior of the organic unit is determined by the experiences of the system to which it belongs. And the recapitulation of them in heredity results, not from the distribution of specialized elements to each area of the organism to be built up, but from the co-operating dynamics of the entire system as a time-and-space whole. The "gemmules" of Darwin, the "micellae" of Nägeli, the "dominants" of Reinke, the "determinants" of Weismann, and the "pangenes" of De Vries, are no more than symbols which look forward to the real explanation. Beneath and beyond them is the determination of the system as part and whole to unfolding and expanding in a particular way. Life is thus cyclical, and death manifestly results from the complexity and interdependence which underlie heredity, and from the heredity that makes insistence on the time-and-space order of change inevitable. The organism is not an object which would go on living for ever were it not attacked, harrassed, and finally worn out by the unceasing onslaught of hostile influences from without. It is a system carried through a cycle of change which, however that cycle may be lengthened, no improvement of the conditions of life will ever enable it to escape. Birth and growth, maturity, old age, death—these are the stages of a time-and-space order on which the dominating system insists, and to which the contributing

units are for ever subordinated. Reproduction is therefore a provision against the inevitableness of death—a means to self-maintenance required by the insistence of the system as time-and-space whole on the organic cycle. The elementary form of death is seen in simple protoplasmic fission; to this is added in the higher organisms the dissolution of the non-reproductive body or soma.

## ORGANIC CAUSATION.

The need of envisaging the organism as a dynamic system, for the explanation of which neither vitalism nor mechanism avails, should now be obvious. In dealing with vital phenomena we are really dealing with what may be called organic causation — the determining and guiding power which the living system exerts over its interrelated and cooperating parts. And by the use of this term it is not meant to set up any absolute distinction between kinds of causation. All it involves is the recognition, not of different species, but of varieties of the same species—not of two wholly unlike sorts of the cause-effect relation, but of that relation as it shows itself, on the one hand in the inorganic, on the other when operative under organic conditions. Inorganic causation may almost be said to define itself by virtue of the fact that it is non-organic. The objects to which it gives rise in the pre-vital world exist as objects independently of one another. In the living body, and none the less really though less obviously in the social system, structures and activities reciprocally imply, require, are needed by, and insist upon each other, with the power of the contributing part subordinated to the power of the dominating whole. Facing nature and society, the human individual finds himself in the grip of two forms of control. On the one hand he is dealing with things which have no organic need of each other; on the other

he is dealt with by beings correlated, interdependent, forming a power system from which he receives and to which he must contribute. In inorganic causation we get a multitude of separate incidences no one of which is dependent on the rest. Organic causation is the product of numbers reciprocally involved, contributing yet subordinated, interdependent yet dominated—a power cumulative from unit to system and refluent from whole to part as a power of self-maintenance.

This domination of the one by the many finds elementary exemplification even before the advent of life. The inorganic unit is never indifferent to numbers; everywhere the one undergoes modification, if not change of property, from its association with the many. As part of an aggregate it is armed with the whole inertia of that aggregate; it then offers greater resistance to impact and moves farther than when acted on alone. And the modification begins earlier than with Ruskin's "little flake of mica sand" which rose from the weakness of isolation to be "knitted into a strength as of imperishable iron" as the citizen of a granite kingdom. Lothar Meyer[1] called attention to "the existence of a connection of some kind between the functions of the parts of a molecule and the composition—using this term in the widest sense—of the whole molecule." The action of an aggregate on its parts is well shown when, in the phenomena known as "elastic reaction," a wire which has been recently and frequently twisted develops a "sense of fatigue" that makes its behavior when again twisted different from that shown when it has been a considerable time at rest. If a bar of nickel steel, when put under a drawing strain, hardens that part of the bar which is nearest to the breaking strain, we are compelled to believe that it is the whole aggregate which, if only in an elementary way, resists the threatened rup-

[1] *Die modernen Theorien der Chemie*, pp. 6, 103.

ture. So in the formation of crystal, as Herbert Spencer[2] suggests, "we are entitled to conclude that the crystallization goes on in each part under the control of all the other parts"—that "the entire aggregate of crystals coerces the molecules in each place, while these in turn join all the rest in coercing those in every other place." Then, with a happy thought whose deep-seated implications he does not seem to have perceived, Spencer infers a similar coercive action exerted by the organism as a whole on its parts, remarking as he is about to extend the analogy, "The thing is done, but it is impossible to imagine how it is done." A pertinent suggestion of how it is done for the organism is given in *The Cell in Development and Inheritance,* where (p. 59) Edmund B. Wilson writes: "As far as growth and development are concerned, it has now been clearly demonstrated that only in a limited sense can the cells be regarded as cooperating units. They are rather local centers of a formative power pervading the growing mass as a whole, and the physiological autonomy of the individual cell falls into the background."

The foundation is the same on whatever aspect of the life process we concentrate our attention. Under inorganic causation the molecules have a merely inorganic relation to one another. They act as molecules of carbon, oxygen, nitrogen, phosphorus, sulphur and what not, and the configurations they will assume can be described in purely physical and chemical terms. But when favored by organic conditions they show the results of a new relation. What each of the molecules shall do is henceforth determined by what all of them must do. The single properties of the units, in a word, are transmuted or merged into a collective property, that of life itself. The so-called vital force imagined by an earlier age, the potency missed by the physico-chemical theories of later date, are just this

[2] *Facts and Comments.*

influence exerted by the dominating system over the contributing yet subordinated units, just this power of the all imposing collective character on each, just this superposition of organic property upon inorganic property, just this lifting of matter from simpler forms in which it is universe-maintained into complex forms that are self-maintained. The driving and directing power of life, buttressed in and derived from the pre-vital cosmos, is thus the organism as a whole. Life adds nothing to the store of energy present in any organic system, nor does death abstract in the least from that store. What happens in the one case, while organic conditions prevail, is the imposition of the law of the whole with which the units have to reckon; what happens in the other, when organic conditions finally cease, is the handing over of the system to the more elementary determinations. The difference between inorganic and organic causation cannot be better illustrated than by contrasting the phenomena which characterize a body while it is alive with the processes that go on in it when it has ceased to live.

In place, therefore, of vague assertions that organic activities have intelligent character, reveal the tendency which Von Baer called *Zielstrebigkeit*, or are mysteriously presided over, according to Hans Driesch, by a "psychoid" which directs without exerting any causal action, we get the account of a process due, under organic conditions, to the impelling and guiding force exerted by the organism as a whole over its own parts, and to the nature of motion as a procession away from conditions of greatest stress towards conditions of equalized stress. We also see the so-called perfecting tendency rationalized and explained by reduction of it to dynamic factors. Not only are the organic units urged into efficient and economic configurations by the resistances they meet with in functioning: the entire organism, by its very nature, is under a differential

stress impelling it as part and whole to higher and more perfect means of self-maintenance, the direction of least stress being the direction which leads to completer division of labor, higher specialization of function, improved forms of reproduction, closer cooperation between members of the species, more complex and finer adjustments to environment. When, therefore, the nutritive and general conditions are favorable, the organism ascends in the scale of life, handing down to its offspring such variations as obtain the support and sanction of the species. We must meanwhile assume that if adaptations in the inorganic do not arise capriciously, there can be no ultimate fortuity in plant and animal. If, in spite of counter currents, there is a vast cosmic drift towards intelligent, enduring forms, the organism cannot be helplessly subjected to the unrule of chance. The variations out of which such forms arise in the interest of life, whether minute and gradual, or saltatory, must be held to acquire their ultimate adaptation, their intelligent character, not fortuitously, but through movement towards definite goals pre-figured by the needs of organic self-maintenance, the character of matter, and the nature of the motion process. And though natural selection may powerfully help to conserve what has been won, the winner of the advantage is always the organism itself.

## INTELLIGENCE PLUS CONSCIOUSNESS.

Recognition of the nature of intelligence as fundamentally dynamic relieves us from the presumed necessity of everywhere reading "psychic powers" into nature as a means of comprehending intelligent adaptations. Why, then, should some of these adaptations be implicated with consciousness? How does it come about that in the organic we have two sets of end-reaching movements—those of the internal processes which do not involve consciousness,

and those of the relational activities which do? It is here assumed that in the inorganic system, lacking the reciprocality above described, there can be no psychic character, minute or massive. But in the simplest protoplasmic system the interdependent units are subject as whole and as part to the shock of all the changes imposed upon them by environment and arising within them as means to maintenance. It is not merely that the disturbance is diffused —it calls forth a reflex movement of all the units, and it is this reciprocal tremor of all of them jointly implicated and reacting which constitutes the objective side of whatever awareness or feeling the incipient organism has thus far reached. As with advancing organization uniformities of outgoing action come to be set up, uniformities of action from without provided for, feeling will be more and more withdrawn from established orders of change and restricted to variations or departures from such orders. For motions that recur with constancy, for processes that go on with unbroken regularity, there is no shock and no reaction of the system: with the one and the many interadapted to them, the regularities are taken up into the very process of the time-and-space whole. Consciousness remains only for those muscular and mental activities which, falling outside routine, evading organization, cannot become automatic. And even for these, with the gradual splitting up of function and division of work, it comes finally to be located in the brain.

Consciousness is thus of the sudden, the irregular, the unaccustomed. How do the organic activities undergo division into usual and unusual? Here the conception of group actions and reactions will aid us. Each specialized tissue, physiological process and organ has the character of a class, since each arises out of a special set of class determinations. It is because the properties of matter exist in classes, and because the incident forces exist in

classes, that the organism must utilize or react on these for self-maintenance by means of processes and organs that constitute classes. Gravitation is an objective class, and has its organic correlate in organs of locomotion; ether and air-vibrations form classes, and have their complements in organs of vision and hearing. Out of the incoming of repeatedly iterated determinations that are likes to each other, requiring continually iterated outgoing actions of fundamentally like kind, arises each organ and process through which self-maintenance is secured. But while organic class is thus the correlate of objective class, there are degrees of resemblance in the conditions of action, incoming and outgoing. In the lower life the correspondence between organization and activities is close: this is the realm of motions requiring little or no choice, of mechanical responses, of reflex action, of the so-called tropisms and, to a greater or less extent, of instinct. As complexity increases, as the impulsion to self-maintenance demands more precise and varied adjustments to environment, as motion and manipulation grow more selective and discriminating, the organism analyses out the original likeness of conditions into differences, with the result that the organic class comes to be split into actions which can be automatically performed and other actions which must be voluntarily and consciously performed. The change occurs not in the physiological processes, which are relatively constant, but in the muscular and mental activities which relate the organism to its surroundings. Some of these are not accompanied by consciousness for the reason that the determining elements are likes to each other; others must be consciously performed because, though belonging fundamentally to the class, the elements differ superficially from each other and thus need effort to include them within it.

This breaking up of the original holophrasm of the

class may be illustrated from the sense-perceptions. In vision, for example, there can at first be only the vaguest sense of light and shade; in the latest stages we find these analyzed out into multifarious varieties by the class organ, the shade definitized as objects, the light split up into colors. So sound, at first a generalized sensation, comes at last to be broken up into differences, with a specialized appliance in the ear for recognizing each. Now all the varieties thus arising belong fundamentally to their class —that of light or sound—and are therefore dealt with by their class organ. But as varieties they have to be won, as it were, from their superficial difference into coalescence with the group to which they belong. For the higher organisms, to be alive means to be ever moving, manipulating, mentally active—means to be involved in constant changes of relation to environment through a complex of experiences in which no two muscular movements, no two mental adjustments, no two cognitions of objects, or even of the same object, can be exactly alike. The brain is thus meeting situations which are at once fundamentally old and superficially new. The whole of organic ascent is, in fact, a progressive analysis of reality into those variations from the class which demand effort for their inclusion within the class. It is for these variants from an original theme, this doing and perceiving of things superficially new yet fundamentally old, that the organized brain mechanisms do not suffice. For them special connections have to be made between the neurons, fresh paths furrowed for the flow of nervous energy; and in these deviations from the customary, from the usual, from the organized, the whole brain engaged in the effort quivers in response, and there is not only the deed, but also the illumination of it which we call consciousness.

Has consciousness any causative or determining part in organic processes? If we mean by consciousness only

our awareness of what we are doing, the reply is that it has not. If we mean by consciousness the physical correlate of that awareness in brain and nervous system, the answer must be that it is so in-and-in woven into the physical changes from which it arises as to be an inseparable factor of them. Originally the shock to which feeling is due could not have been more than a sort of by-product of the functioning of organic matter in self-maintenance. In the long, slow evolution of life from lower to higher, and finally to highest stages, it must have been gradually interorganized with the rest of the physiological processes. It has thus become an indispensable part of those processes, not in the sense of determining their occurrence, of being their *raison d'être*, but in the sense of helping to make up a whole of interadapted actions all of which require each, each of which is necessary to all, with the result that specific kinds of psychical change are kept inseparably linked with particular sorts of physical change. That the objective shock should appear to us as consciousness remains inexplicable, as is sufficiently shown by the difficulty of describing awareness in other than terms of itself. The illumination we have as conscious is an irreducible fact, set off by its uniqueness of character from all other facts. All we can say of it is that it subsumes in brain and nervous system a highly specialized form of the same reciprocality of power which the universe itself displays. For all grades of feeling there is needed that relation of the implicated one to the including many, that swift interchange between the dominating many and the subordinated one, which are possible only in living matter and within the narrowly delimited areas of organic systems. If on the objective side consciousness is the attitude of the system towards unusual and unorganized changes within it, on the subjective side it is such changes seen in the many-faceted mirror for

which each organic unit, reflecting and reflected, is also at once thing and image of thing to all the organic units.

In consciousness, as in everything else pertaining to life, we thus come back to the organism wielding itself, in possession of itself—to a system arising out of nature, belonging to nature, yet none the less set off from nature by organic causation and the activities of self-maintenance. It is only because our psychical states are conspicuous, the physical states which produce them concealed, that we have been eager to promote consciousness to causal rank over that which originates it; only because the obvious teleology of our voluntary activities, muscular and mental, shuts us out from the teleology of the process which underlies them, that we have clung obstinately to the view which makes consciousness the principle of intelligence and the driving power of life. Little as we can scrutinize the physical correlates of our conscious states, we are bound to assume that all these states without exception, from the simplest feeling of discomfort to the highest flights of abstract thought, are founded in non-psychical processes, and fit these as the cast fits the mould. The set which we have towards life and life's activities is plainly imposed, not primordially by the feelings we have as knowers, but primordially by the physical body we inherit and wield as doers. As the real source of organic teleology is not a psychical principle, but the nature of the organism plus the motion process, so the real guide to intelligent adaptations is not consciousness, but the ends implicit and demanding realization in a system under impulsion to maintain itself. Finding consciousness associated only with some of the organic activities and absent from the whole of the inorganic world, we are compelled to regard it as a peculiar and narrowly delimited aspect of reality, and at the same time a superficial, not a fundamental aspect of life. Finding teleology in both organism and universe,

we are compelled to trace it not to a psychical, but to a dynamic principle. Consciousness suffers nothing by being delivered from the embarrassment of irrational claims. It rises in dignity the more we can view it as the outcome of a process deeper than its own; it becomes more precious to us the more closely we can link it with life; it takes highest rank when, as revealer, it patterns forth, however imperfectly and unsatisfactorily, something of the wonderful resources of the organism and the inexhaustible richness of cosmic power.

### CHANGE AND ENDURANCE.

Power is here regarded, not as an aggregated multiplicity, but as a divisionalized unity. Its differentiation into material units makes groupings, collocations, moving systems and configurations of them possible. The impulsion of the cosmic system to self-maintenance, its conversion of differential stresses through motion into equalized stresses, result in the arrangements we call intelligent adaptations. The "end" of maintenance, of endurance, is implicit in the nature of the system, whether inorganic or organic; it finds realization through the displacements and replacements which the system imposes. Contrivance or design in nature is the elementary form of the end-reaching we witness and practise in our own lives as organisms. Out of a process which has endurance for its goal emerges in both living and not-living the intelligence of "intelligent adaptations." In accepting this view we deliver purposiveness in nature from its supposed origin in psychic elements; the notion of a cosmos ruled by mind widens out into the thought of a cosmos potential of mind, as well as of possibilities unutterably beyond the grasp of mind; the appeal to the argument from design yields to the argument from the nature of power. Purposiveness in life is meanwhile emancipated from both vitalistic and

mechanistic assumptions—from the crude symbolism of the one, from the narrow empiricism of the other. The organism is under determination: in all its acting and developing the cause-effect relation may be traced. But as a self-maintainer it is none the less relatively self-centered, self-acting, autonomous. The physico-chemical properties of matter are servants, not masters in the house of life. The determinism is that of a system that wields itself. The freedom involved is that of organic causation.

The cosmic flux, like the organic flux, must be regarded as a means to endurance. Change is eternal, but things flow and continue to flow in the same general way, in modes that can be relied on and predicted: the vicissitudes succeed each other, their order remains. There are plenty of unteleological conflicts in nature, yet the emergence of enduring form—there as suns, planets and their furnishings, here as the crowded display of the organic world—shows beyond peradventure a final triumph of the collectivizing over the dissipating, the purposive over the fortuitous tendencies. As motion in the inorganic ensures the conservation of power, so changes in the organism are means to self-maintenance. The functions of life in the moneron and in man do not essentially differ; the class frameworks remain throughout organic ascent—it is only their content which undergoes multiplication and enrichment. In human activities, in tools and machines, even in social and political systems, men work towards the things which endure. Speech is a body of signs whose general character survives all changes; human thought, through whatsoever vicissitudes and controversies, keeps its fundamental elements unmodified. There is an inertia of mind as well as of matter, a conservation of ideas as well as of energy. The drift of science is towards a body of truths that shall endure; sure foothold in their own affirmations is also the quest of the theologians. The world's

great thinkers still "beacon from the abode where the eternal are."

Insistence on the flow of things is thus only half the story. All material objects are time-and-space wholes: only as such, and as arising out of the cosmic whole, can we have reliable knowledge of them. To sum them up as present existences in time or as local existences in space is to cut them off from the universe. Even if we could isolate the flow from the things that flow, we should need to take account of its direction and end. Only by realizing the flux as teleological, as a working towards intelligent forms, do we grasp the meaning of change, and to that extent the meaning of reality. The changes that seem to expend power do but insure its continuance. The power that changes not survives all change as the very possibility of change. The French poet spoke more wisely than he knew when he declared that "nothing endures eternally, in order that all may endure."

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